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Environmental Challenges of Climate-Nuclear Fusion: A Case Study of India

*Deepa Badrinarayana**

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I.

INTRODUCTION

Climate change is launching a nuclear energy future because nuclear power generation produces low greenhouse gas emissions.¹ Nations are therefore reviewing their nuclear energy portfolio and expanding international cooperation on civilian nuclear energy.² India is a notable example. Recognizing India's energy demands and the climate mitigation problems associated with fossil fuel use, the Nuclear Supplier's Group, at the behest of the United States, removed nuclear trade sanctions imposed on India.³ India has subsequently been negotiating and signing numerous bilateral agreements aimed at expanding its domestic nuclear power generation facility.⁴ The apparent advantages of nuclear energy in mitigating climate change are however significantly marred by international and domestic regulatory and governance gaps in assessing and managing the environmental impacts of nuclear energy.⁵

Although partially promoted to mitigate climate change, nuclear technology is not featured as an energy alternative in international climate treaties because of persisting environmental, safety, and cost concerns.⁶ The Indian government's assessment of the legal framework to manage environmental and safety impacts of nuclear expansion, including waste management, does not match its alacrity in concluding nuclear agreements.⁷

In this article it is argued that India's nuclear policy represents an upcoming challenge to environmental law for two reasons. First, it shows that the international community's support for India's civilian nuclear program, despite the exclusion of nuclear energy for safety, security, and cost reasons, will not yield timely emissions reduction benefits because of sketchy international and domestic energy policy and poorly aligned emissions reduction and energy diversification goals. Second, the expansion of India's civilian nuclear program demonstrates that nations have given scant attention to developing an adequate legal framework for managing serious associated environmental problems such as

1. See *infra* note 46 & accompanying text.

2. See *infra* notes 47-78 & accompanying text.

3. *Id.*

4. See *infra* notes 79-108 & accompanying text.

5. See *infra* notes 24-46 & accompanying text.

6. *Id.*

7. See *infra* notes 79-108 & accompanying text.

waste management, siting, and liability. Without a comprehensive and cohesive international regime on nuclear energy, these issues present serious environmental concerns both locally and globally.

This case study demonstrates that a meaningful strategy to mitigate climate change must, without exacerbating other environmental problems, align national and international law and policy on three indivisible aspects of the problem: emissions, energy, and economics. The current approach to climate mitigation focuses primarily on emissions reduction goals, which may actually drive nations to pursue environmentally detrimental energy alternatives such as nuclear energy. This reality cannot be wished away by excluding a particular type of energy from the climate treaties. Instead, nations may have to take a more stringent approach and establish a climate assessment system under which certain types of energy will be phased out. A mechanism to simultaneously assess the environmental impacts of energy alternatives such as nuclear power must also be considered to ensure that alternatives achieve the requisite steep emissions cuts.

This article proceeds in seven parts. Part II discusses the general lassitude of nations towards nuclear energy. Part III examines the continuing opposition to including nuclear energy within the purview of the international climate regime of treaties. Part IV analyzes the resurgence of nuclear energy on the coattails of climate change despite its exclusion from the international climate regime. Part V presents a case study of India's civilian nuclear program to demonstrate that the foundations for a nuclear energy future have been established. Part VI presents arguments showing that India's nuclear energy program will not help address climate change and that regulatory and administrative gaps in nuclear energy management may in fact set the stage for future local and global environmental governance problems. The final and concluding section proposes that, in light of lessons from nuclear energy expansion, nations must not only focus on changing time-bound emissions reduction targets but also on phasing out or regulating technologies that affect the environment. A failure to seriously reconsider both climate mitigation and energy deployment strategies may result in further deterioration in environmental governance, in addition to a potential climate catastrophe.

II.

NUCLEAR ENERGY USE WAS A CONTENTIOUS
PUBLIC ISSUE BEFORE CLIMATE CHANGE
EMERGED AS A PROBLEM

Nuclear energy use for electricity generation began at the end of World War II.⁸ The United States government established the Atomic Energy Commission (AEC) in 1946 to promote nuclear energy research for peaceful use.⁹ By 1954, AEC had launched a vigorous domestic program, including the five-year-long Reactor Development Program, both to boost its civilian nuclear plans and to respond to potential threats of the Cold War.¹⁰ Towards 1957, the United States' foreign policy favored transnational sharing of nuclear technology for peaceful purposes under the supervision of the International Atomic Energy Agency (IAEA).¹¹ The AEC predicted that by the year 2000 nuclear energy would be a principal source of power generation¹² if it could compete with coal.¹³

Citizens and states concerned about several consequences, such as nuclear fallout, diversion or theft of materials, thermal pollution, radioactive waste management, and the effect of radiation on health particularly after a near meltdown of a nuclear plant in Detroit in 1966,¹⁴ tempered the federal government's civilian nuclear program ambitions.¹⁵ In *Calvert Cliffs' Coordinating Committee, Inc. v. U.S. Atomic Energy Commission*¹⁶ the D.C. Circuit also established stringent legal checks by holding that under the National Environmental Policy Act (NEPA), the federal agency proposing the project had to consider all environmental impacts of their projects including, in the case of AEC, non-radiological environmental impacts of nuclear plants before

8. ANNA GYORGY, *NO NUKES: EVERYONE'S GUIDE TO NUCLEAR POWER* 7 (1979).

9. *Id.*

10. *Id.* at 10.

11. *Id.* at 9; INT'L ATOMIC ENERGY AGENCY (IAEA), <http://www.iaea.org/About/index.html> (last visited Nov. 6, 2010).

12. *Id.* at 14.

13. *Id.*

14. Oliver Houck, *Unfinished Stories*, 73 U. COLO. L. REV. 867, 883 (2002).

15. GYORGY, *supra* note 8, at 15–16, 29.

16. 449 F.2d 1109 (D.C. Cir. 1971) (addressing challenge to the Nuclear Regulatory Commission (NRC) regulation limiting NEPA review to only radiological issues).

granting construction permits.¹⁷ This interpretation of NEPA increased costs of nuclear power construction and led to a decline in the U.S. nuclear energy program, particularly when the U.S. government introduced several energy conservation measures in the 1990s.¹⁸

Nuclear power plants accidents such as Three Mile Island and Chernobyl¹⁹ considerably slowed down commercial nuclear energy programs. Several nations either imposed regulatory bans on nuclear reactors or adopted policy measures to phase out nuclear reactors²⁰ because of environmental and public health and safety concerns. In 1998, the International Energy Agency (IEA) predicted in its annual publication, *World Energy Outlook (WEO)*, that nuclear energy as a primary fuel would eventually decline in the Organization for Economic Cooperation and Development (OECD) Europe and OECD North America.²¹ Nuclear energy expansion was primarily anticipated in the OECD Pacific.²² However, India's nuclear future at that point was less promising because of international sanctions.²³ Thus, nuclear en-

17. *Id.* at 1117-20 (rejecting NRC's interpretation that non-radiological environmental issues do not need to be considered under the NEPA unless specifically raised because it contravened NEPA's mandate that environmental impacts be considered to the "fullest extent").

18. Houck, *supra* note 14, at 891 (describing how Congress eliminated the nuclear breeder reactor program). According to a 1998 report by the Energy Information Administration (EIA) of the Department of Energy (DOE), 19% of electricity that was generated by nuclear power would reduce significantly by 2020 because of market conditions, existing regulations, and the relatively low cost of coal. ENERGY INFO. ADMIN., DEP'T OF ENERGY, DOE/EIA-0623, CHALLENGES OF ELECTRIC POWER INDUSTRY RESTRUCTURING FOR FUEL SUPPLIERS 25-41 (1998), available at http://www.eia.doe.gov/pub/electricity/chg_str_fuel.pdf.

19. JOHN G. KEMENY ET AL., REPORT OF THE PRESIDENT'S COMMISSION ON THE ACCIDENT AT THREE MILE ISLAND, THE NEED FOR CHANGE: LEGACY OF TMI (1979) (on file with author); IAEA, THE INTERNATIONAL CHERNOBYL PROJECT: ASSESSMENT OF RADIOLOGICAL CONSEQUENCES AND EVALUATION OF PROTECTIVE MEASURES 3 (1991), available at http://www.pub.iaea.org/MTCD/publications/PDF/PIA32e_web.pdf.

20. See DR. FATIH BIROL, ORG. FOR ECON. COOPERATION AND DEV., BUSINESS AS USUAL AND NUCLEAR POWER 26 (2000), available at <http://www.iea.org/textbase/nppdf/free/2000/busassual2000.pdf>.

21. INT'L ENERGY AGENCY [IEA], WORLD ENERGY OUTLOOK 208 fig.12.2 (1998), available at <http://www.iea.org/textbase/nppdf/free/1990/weo1998.pdf> [hereinafter WEO 1998] (showing a decline in nuclear energy from 9% in 1995 to 4% in 2020 in OECD North America despite an overall increase in energy use); see also *id.* at 187 fig.11.8 (showing a gradual decline in nuclear power in OECD Europe between 1996 and 2020).

22. BIROL, *supra* note 20, at 25.

23. For a brief discussion of the background to the United States and the Nuclear Supplier's Group imposing sanctions on India (and Pakistan) following their nuclear

ergy was not considered a good option from an environmental, safety, or cost perspective.

III.

INCLUSION OF NUCLEAR ENERGY IN INTERNATIONAL CLIMATE AGREEMENTS REMAINS CONTENTIOUS

Skepticism about the environmental and health impacts of nuclear energy prevails to the extent that some nations continue to reject its inclusion within the international climate change regime. As illustrated by the United States, persisting public opinion against nuclear facilities reflects serious concerns about security and environmental safety.²⁴ As the controversy surrounding the designation of Yucca Mountains in Nevada as a permanent nuclear waste repository highlights, nuclear waste management is one critical concern. The D.C. Circuit²⁵ agreed that nuclear waste management warranted serious consideration when it set aside the Environmental Protection Agency's (EPA) designation for setting its compliance period of safety standards for only ten thousand years instead of the one million years recommended by the National Academy of Sciences.²⁶ Debate about the storage of nuclear waste continues pending review of the site, and an administrative court has disallowed the Obama administration from withdrawing the site.²⁷

tests, see Sean D. Murphy, *Contemporary Practice of the United States Relating to International Law*, 93 AM. J. INT'L L. 470, 498-500 (1999).

24. MIT STUDY, *infra* note 28.

25. *Nuclear Energy Institute Inc. v. Env'tl. Prot. Agency*, 373 F.3d 1251, 1315 (D.C. Cir. 2004).

26. *Id.* at 1262-64, 1267, 1273. Here the EPA promulgated rules to ensure public safety against radiation and to prevent ground water pollution from the Yucca Mountain Repository. The compliance period for meeting these safety standards was set at 10,000 years. The DOE could receive a license from the NRC only if it demonstrated that it would be able to meet the EPA standards for 10,000 years. However, the EPA's compliance period was contrary to the National Academy of Sciences' (NAS) recommendation that the compliance period at the Yucca Mountain Repository be 1,000,000 years because of the longevity of the nuclear waste. Nevada challenged the EPA's compliance standard on the ground that it had violated Section 801 of the Energy Policy Act, which required the EPA to follow the recommendations of the NAS in regulating nuclear waste. The D.C. Circuit held that the EPA had violated Section 801 by not following NAS recommendations and that the EPA standards could only be legal if they complied with NAS recommendations or if Congress changed the legislative requirement set under the Energy Policy Act.

27. *In re U.S. Dep't of Energy, N.R.C. No. 63-001-HLW, ASLBP No. 09-892-HLW-CAB04*, slip op. at 3 (June 29, 2010), available at <http://www.state.nv.us/nuc/waste/licensing/order100629deny.pdf>. The NRC denied the DOE's request to with-

A Massachusetts Institute of Technology (MIT) study affirms that public opposition to nuclear energy deters nuclear technology development.²⁸ Similarly, in a briefing paper submitted to the House of Representatives the United States Energy Information Administration noted that public opposition to nuclear energy impeded proper cost-benefit analysis of nuclear energy in the climate change context.²⁹ It particularly noted that investor return on nuclear energy could not be assessed because even citizens who favored nuclear energy generally opposed the construction of nuclear reactors in their local communities.³⁰

Furthermore, the international climate change regime excludes nuclear energy. Efforts to include nuclear energy as a climate mitigation technology under the Clean Development Mechanism (CDM), which would permit Annex I Parties to the Protocol to claim emissions reduction credits for investing in nuclear power plants in non-Annex I nations,³¹ and efforts to include nuclear

draw for public interest reasons an application to designate Yucca Mountain as a waste site pending before the NRC on the ground that Congress had mandated the DOE under the Nuclear Waste Policy Act in 1987 to limit site selection to the Yucca Mountain and to submit an application to the NRC for review, but had not authorized the DOE to withdraw an application pending review by the NRC. *Id.* at 6-8. See also Richard M. Jones, *Nuclear Regulatory Commission Board Rejects Administration's Attempt to Stop Yucca Mountain Construction Authorization Review*, AM. INST. OF PHYSICS (July 12, 2010), <http://www.aip.org/fyi/2010/072.html> (providing an overview of the N.R.C. decision). For a full discussion of the issues regarding the use of Yucca Mountain as a nuclear waste repository, particularly from the viewpoint of the position of Nevada, see Marta Adams, *Yucca Mountain—Nevada's Perspective*, 46 IDAHO L. REV. 423 (2010).

28. STEPHEN ANSOLABEHERE ET AL., *THE FUTURE OF NUCLEAR POWER: AN INTERDISCIPLINARY MIT STUDY 6* (2003) [hereinafter *MIT STUDY*], available at <http://web.mit.edu/nuclearpower/pdf/nuclearpower-ch1-3.pdf> (noting that U.S. public support for nuclear energy depended on technology improvements and costs involved and that the U.S. public did not connect a global warming solution to nuclear energy). However, a 2009 update to the MIT Study noted that public support for nuclear energy had increased since 2003. JOHN M. DEUTCH ET AL., *Update of the MIT 2003 Future of Nuclear Power: An Interdisciplinary MIT Study 5* (2009), available at <http://web.mit.edu/nuclearpower/pdf/nuclearpower-update2009.pdf>.

29. See ENERGY INFO. ADMIN., DEP'T OF ENERGY, SR/OIAF No. 98-03, *IMPACTS OF THE KYOTO PROTOCOL ON U.S. ENERGY MARKETS AND ECONOMIC ACTIVITY 137-46* (1998), available at <http://www.eia.doe.gov/oiaf/kyoto/pdf/sroiaf9803.pdf>. The EIA prepared the report for the Committee on Science of the U.S. House of Representatives to project the cost implications of signing the Kyoto Protocol.

30. *Id.* See also Darren K. Carlson, *Public Warm to Nuclear Power, Cool to Nearby Plants*, GALLUP (May 3, 2005), <http://www.gallup.com/poll/16111/Public-Warm-Nuclear-Power-Cool-Nearby-Plants.aspx>.

31. See IAEA, *NUCLEAR POWER FOR GREENHOUSE GAS MITIGATION UNDER THE KYOTO PROTOCOL: THE CLEAN DEVELOPMENT MECHANISM (CDM) 2-5* (2000) [hereinafter *IAEA ON CDM AND GHG MITIGATION*], available at <http://www.iaea.org/Publications/Booklets/GreenhouseGas/greenhousegas.pdf> (explaining

energy under the Joint Implementation (JI) mechanism of the Protocol³² have consistently failed, despite support from major industrialized nations.

For example, an International Atomic Energy Agency (IAEA) study on the linkage between nuclear energy and greenhouse gases reports that five nations, including China and India, favored the inclusion of nuclear technology transfer under CDM to take advantage of the savings in greenhouse gas emissions and to mitigate the high costs of nuclear power plant construction.³³ The United States also supported the inclusion of nuclear energy within the climate regime earlier during the Kyoto Protocol negotiations.³⁴ At the meeting of the Conference of Parties (COP) in Bali, Japan reiterated its continuing support for nuclear energy³⁵ and its commitment to expanding nuclear energy generation.³⁶

The third Conference of Parties (COP 3) to the United Nations Framework Convention on Climate Change (UNFCCC)³⁷ also considered including nuclear energy under CDM.³⁸ How-

briefly the possibility for including nuclear energy within the Kyoto Protocol's Clean Development Mechanism).

32. *Id.*

33. IAEA ON CDM AND GHG MITIGATION, *supra* note 31.

34. See *Nuclear Energy Key for Developing Nations To Meet Carbon Reduction Goals, Climate*, NUCLEAR ENERGY INST. (Nov. 17, 2000), <http://www.nei.org/newsandevents/developingnationsgoal/> (reporting that several United States senators and the U.S. negotiators at the Kyoto Protocol supported the inclusion of nuclear energy under the Kyoto Protocol CDM).

35. See, e.g., VIEWS ON THE SYNTHESIS OF INFORMATION RELEVANT TO THE DETERMINATION OF THE MITIGATION POTENTIAL AND TO THE IDENTIFICATION OF POSSIBLE RANGES OF EMISSION REDUCTION OBJECTIVES OF ANNEX I PARTIES, U.N. Doc. FCCC/KP/AWG/2007/MISC.5 4 (2007) [hereinafter Japan's Submission], available at <http://unfccc.int/resource/docs/2007/awg4/eng/misc05.pdf>. Japan noted that nuclear energy should be added as a "low or zero GHG emitting" source. It also called for involvement of IEA with UNFCCC in addressing climate change and for the promotion of advanced nuclear technology in the Bali Action Plan. The World Nuclear Association anticipates a 40% increase in Japan's nuclear energy by 2017. *Nuclear Power in Japan*, WORLD NUCLEAR ASS'N, <http://www.world-nuclear.org/info/inf79.html> (last visited Feb. 28, 2011).

36. The World Nuclear Association anticipates a 40% increase in Japan's nuclear energy by 2017. *Nuclear Power in Japan*, WORLD NUCLEAR ASS'N, <http://www.world-nuclear.org/info/inf79.html> (last visited Feb. 28, 2011).

37. United Nations Framework Convention on Climate Change, *opened for signature* June 4, 1992, 1771 U.N.T.S. 107 (entered into force Mar. 21, 1994).

38. Ichiro Ikemoto, *Nuclear Power and the Kyoto Mechanism*, in WATER, STEAM AND AQUEOUS SOLUTIONS FOR ELECTRIC POWER: ADVANCES IN SCIENCE AND TECHNOLOGY, PROCEEDINGS OF THE 14TH INTERNATIONAL CONFERENCE ON THE PROPERTIES OF WATER AND STEAM 730 (Masaru Nakahara, Nobuyuki Matubayasi, Masaktasu Ueno, Kenji Yasuoka, and Koichi Watanabe eds., 2005),

ever, the Bonn Agreement specifically prohibits credits allocations for nuclear energy investments under the flexible mechanisms JI and CDM.³⁹ The Marrakesh Accord adopted by COP 7 reiterates the Bonn Agreement position.⁴⁰ In an Ad Hoc meeting prior to COP 13 in Copenhagen, the Parties reopened discussions on including nuclear energy under the flexible mechanisms for the second commitment period (after 2012).⁴¹

A pre-Copenhagen Working Group considered three options: 1) maintain status quo and disqualify nuclear facilities from receiving credits under CDM; 2) prohibit Annex I Parties from generating certified emissions reduction units from nuclear facilities to meet their emissions reduction obligations; or 3) recognize nuclear energy-based emissions reduction generated by nuclear facilities constructed in or after 2008 under CDM, subject to advice from the Subsidiary Body for Scientific and Technological Advice regarding the appropriate measures.⁴² In pre-Copenhagen talks, China, a major emitter and an indispensable climate negotiator, pegged its climate policy to its nuclear technology policy. China may thus construct one hundred nuclear facilities in the next twenty years.⁴³ China's position mirrors that of several developing countries that seek inclusion of nuclear technology under CDM; these nations may also attract investments because of the absence of strong, documented public opposi-

available at <http://www.iapws.jp/Proceedings/Symposium15/729Ikemoto.pdf>; see also Tetsuhiro Hirose, *Heated Discussion on Nuclear Power Generation*, KYOTO SHIMBUN NEWS, Dec. 6, 1997, <http://www.kyoto-np.co.jp/kp/english/special/cop3/cop7120601e.html>.

39. U.N. Framework Convention on Climate Change (UNFCCC), Rep. of the Conference of the Parties, Sixth Session, July 16-27, 2001, U.N. Doc. FCCC/CP/2001/5 (Sept. 25, 2001), available at <http://unfccc.int/resource/docs/cop6separt/05.pdf>.

40. UNFCCC, Rep. of the Conference of the Parties, Seventh Session, Oct. 29-Nov. 10, 2001, 2, U.N. Doc. FCCC/CP.2001/13/Add.2 (Jan. 21, 2002), available at <http://unfccc.int/resource/docs/cop7/13a02.pdf>.

41. Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol, Twelfth Session, June 1-11, 2010, Addendum to the Emissions Trading and the Project Based Mechanisms, 2, U.N. Doc. FCCC/KP/AWG/2010/6/Add.3 (Apr. 29, 2010), available at <http://unfccc.int/resource/docs/2010/awg12/eng/06a03.pdf>.

42. *Id.* at 3.

43. *China's Pre-Copenhagen Climate, Nuclear Goals Coincide*, NUCLEAR ENERGY INST. (Dec. 7, 2009), <http://www.nei.org/resourcesandstats/publicationsandmedia/insight/insight-web-extra/chinas-pre-copenhagen-climate-nuclear-goals-coincide/>; see also *China Offers Argentina Nuclear Power Technology*, HINDUSTAN TIMES, July 15, 2010, <http://www.hindustantimes.com/China-offers-Argentina-nuclear-power-technology/Article1-572592.aspx>.

tion.⁴⁴ However, the nuclear energy option does not feature in the Copenhagen Accord or other instruments.⁴⁵ Thus, nations remain ambivalent about formally deploying nuclear energy to mitigate climate change.

Despite this prevailing ambivalence, in some countries such as India, nuclear energy is shaping climate policy. Therefore, as discussed below, nuclear energy is gaining traction because of climate change outside the international climate regime, creating legal anomalies with serious environmental repercussions.

IV.

CLIMATE CHANGE HAS NEVERTHELESS REVIVED THE CIVILIAN NUCLEAR ENERGY OPTION

Climate change concerns have reversed nuclear energy use trends in OECD nations, boosted expansion plans in OECD Pacific, and rejuvenated commercial, civilian nuclear energy use in non-OECD nations such as India. Climate change has revived the nearly dormant nuclear industry for at least two important and obvious reasons. First, nuclear power plants do not spew large amounts of harmful emissions, among them greenhouse gas emissions that cause global warming. According to one IAEA estimate, nuclear technology could potentially reduce the proportionate emissions share of power plants by about forty percent.⁴⁶ The MIT study predicts that based on current projections, nuclear energy could reduce up to a 25% increment in coal use by 2050.⁴⁷ OECD's Nuclear Energy Agency (OECD-NEA) estimates that continuous nuclear energy development could eliminate nearly 200 Gigatonnes (Gt) of CO₂ by 2050, as opposed to

44. See, e.g., Fang Dong & Li Hong, *Clean Development Mechanism and Nuclear Energy in China*, 73 PROGRESS IN NUCLEAR ENERGY 107, 107-11 (2000) (arguing that nuclear energy provides an opportunity to reduce emissions in China and that CDM was an opportunity to increase investments). See also R. Ramachandran, *A Case for Nuclear Energy*, FRONTLINE (Nov. 23-Dec. 6, 2002), <http://www.flonnet.com/fl1924/stories/20021206005911700.htm> (reporting that COP 8 promised inclusion of nuclear energy under CDM and that developing countries supported such inclusion).

45. UNFCCC, Report of the Conference of the Parties, Fifteenth Session, Dec. 18, 2009, Copenhagen Accord, 5, UN Doc. FCCC/CP/2009/11/Add.1 (Mar. 30, 2010) [hereinafter Copenhagen Accord], available at http://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf.

46. IAEA, IAEA Doc. IAEA/PI/A72E, CLIMATE CHANGE AND NUCLEAR POWER 10 (2000) [hereinafter IAEA 2000], available at http://www.iaea.org/Publications/Booklets/ClimateChange/climate_change.pdf.

47. MIT STUDY, *supra* note 28, at 28.

100Gt or 55Gt if nuclear plants were phased out or even phased out and revived later, respectively.⁴⁸ In a Parliamentary publication, Australia implicitly emphasized the inevitability of nuclear energy reliance by nations that had accepted emissions reduction obligations.⁴⁹

Consequently, even nations decommissioning or phasing out nuclear power plants are seriously reviewing their policy. For example, the United Kingdom is considering the expansion of its nuclear facilities.⁵⁰ More significantly, the Nuclear Suppliers Group (NSG) waived sanctions on the supply of nuclear materials and technology to India, primarily to enable the sub-continent to develop with lower climate impact.⁵¹ The promise of emissions reduction has obviously revived commercial nuclear energy.

A second reason for the resurgence of nuclear power is climate change regulation. Climate regulation can improve competitiveness of nuclear energy with coal. Generally, in addition to environmental, safety, and security concerns, the high cost of nuclear power plant construction and maintenance relative to the cost of fossil fuels such as coal deters civilian nuclear energy development.⁵² The 1998 WEO predicted that with the exception of OECD Europe, high costs would drive down nuclear power generation and encourage coal and oil use.⁵³ The study attributed the decline in nuclear energy in OECD North America to an increase in coal-based electricity generation.⁵⁴ Similarly, it noted that in China the higher cost of nuclear energy—three times that

48. NUCLEAR ENERGY AGENCY [NEA], NUCLEAR POWER AND CLIMATE CHANGE 25-26 (n.d.), available at <http://www.nea.fr/ndd/climate/climate.pdf>.

49. Paul Kay, *Terms and Impacts of the Kyoto Protocol*, PARLIAMENT OF AUSTRALIA (Mar. 9, 1998), available at <http://www.aph.gov.au/library/pubs/cib/1997-98/98cib10.htm> (noting that countries with more stringent emissions reduction targets either included nuclear power in their energy mix or imported nuclear energy).

50. See WEO 1998, *supra* note 21, at 46 (discussing expansion of nuclear energy in the United Kingdom).

51. See *infra* Part V (discussing the opening of civil nuclear energy supply to India).

52. According to the IEA's WEO 1998, the cost of fossil would have to increase substantially to make nuclear energy competitive in the United States. WEO 1998, *supra* note 21, at 217 tbl.12.11.

53. *Id.* at 218-220. In OECD Europe, nuclear power generation increased between 1971 and 1980, but was also predicted to decrease by 2020. WEO 1998, *supra* note 21, at 183-86. This estimate did not include non-OECD European Union countries. *Id.* at 197.

54. WEO 1998, *supra* note 21, at 207, 214.

of coal per kilowatt—made a weak case for development of nuclear power plants.⁵⁵

Climate regulation can change this cost dynamic by placing a price on carbon emissions. Such regulation will increase costs of coal-based power and make alternative sources of electricity that are capital intensive, such as nuclear energy, cost effective.⁵⁶ Presently, because of checkered global carbon regulation combined with other factors such as long-term waste disposal, fuel cycle, and risk of proliferation, nuclear energy remains an expensive source of electricity.⁵⁷ Nations are therefore considering measures to increase the cost effectiveness of nuclear energy in the context of climate regulation. For example, the U.S. Department of Energy (DOE) has been studying gaps in and strategies for increasing the competitiveness and rapid deployment of nuclear energy in the United States.⁵⁸ A detailed DOE report recommended several measures, including: 1) taking into account low natural gas prices and potential carbon non-regulation at the R&D stage so as to eliminate non-competitiveness of nuclear technology; and 2) implementing a 1989 NRC regulation (10 CFR § 50) that would expedite “Early Site Permit (ESP), Design Certification (DC), and Combined License (COL).”⁵⁹ The DOE correctly reports that these measures can create the requisite incentives for the nuclear industry to take advantage of potential regulation of carbon emissions through tax or sequestration requirements.⁶⁰

The MIT study also recommends the inclusion of nuclear energy in a national carbon-free or renewable energy portfolio.⁶¹ The Obama administration, its views on Yucca Mountain notwithstanding,⁶² supports investment in nuclear technology. In his

55. *Id.* at 290.

56. IAEA 2000, *supra* note 46, at 23-24. *See also* MIT STUDY, *supra* note 28, at 7-8 (noting that a carbon tax or an equivalent cap and trade system can make nuclear energy economically feasible).

57. MIT STUDY, *supra* note 28, at 7-8.

58. *Nuclear Power 2010: Program Activities for the Deployment of Nuclear Power*, DEP'T OF ENERGY, <http://www.ne.doe.gov/np2010/activities.html> (last visited Jan. 11, 2011). *See also* TONY MCCONNELL ET AL., DEP'T OF ENERGY, SUMMARY REPORT, VOL. 1: A ROADMAP TO DEPLOY NEW NUCLEAR POWER PLANTS IN THE UNITED STATES BY 2010 31 (2001), available at <http://www.ne.doe.gov/nerac/neracPDFs/nt-droadmapvolume1.pdf> (providing expert evaluations and recommendations for the Nuclear Power 2010 program).

59. MCCONNELL ET AL., *supra* note 58, at 1, 3-4.

60. *Id.* at 2-3.

61. MIT STUDY, *supra* note 28, at 8.

62. *In re* U.S. Dep't of Energy, *supra* note 27.

February 2011 State of the Union address, President Obama pledged support for new, safe nuclear technology development and has proposed to increase government loan guarantees to the industry to \$54 million in his 2011 budget.⁶³

The regulatory situation in more advanced Europe is different, because European states are signatories to the Kyoto Protocol and have accepted binding emissions reduction obligations.⁶⁴ The costs of nuclear energy can already be measured against the cost of carbon emissions. For example, in 2007 the World Energy Council (WEC) reported that notwithstanding uncertainty regarding the exact costs of nuclear power generation, nuclear energy in Europe was not subject to the financial risks associated with regulation of CO₂ emissions, unlike carbon- and coal-fired and CCGT power plants that would be affected if carbon prices reached 20 tCO_2 .⁶⁵ WEC therefore concluded that nuclear energy costs in Europe would decrease subject to environmental regulations.⁶⁶ European nations that planned to phase out nuclear power plants are already witnessing a nuclear renaissance.

Some European nations are reconsidering their nuclear energy policies in light of climate regulation.⁶⁷ For instance, in a report to the Parliament the United Kingdom government noted that the nation could not reduce emissions and at the same time meet its energy needs without including nuclear power in its energy mix. The report recommended the preservation of the nuclear option either by replacing power plants slated for closure by 2023

63. *The Federal Budget, Fiscal Year 2011*, DEP'T OF ENERGY, OFFICE OF MGMT & BUDGET, http://www.whitehouse.gov/omb/factsheet_department_energy/ (last visited Oct. 11, 2010); Peter Behr, *DOE Delivers Its First, Long-Awaited Nuclear Loan Guarantee*, N.Y. TIMES, Feb. 17, 2010, <http://www.nytimes.com/cwire/2010/02/17/17climatewire-doe-delivers-its-first-long-awaited-nuclear-71731.html>; Steven Mufson, *Obama 2011 Budget Request: Energy Department*, WASH. POST, Feb. 1, 2010, <http://www.washingtonpost.com/wpdyn/content/article/2010/02/01/AR2010020101794.html> (reporting that budget for Yucca Mountain would be terminated).

64. *Status of Ratification of the Kyoto Protocol*, UNFCCC, http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php (last visited Feb. 10, 2011).

65. ANDRÉ CAILLÉ ET AL., WORLD ENERGY COUNCIL, THE ROLE OF NUCLEAR POWER IN EUROPE 71 (2007) [hereinafter WEC REPORT], available at http://www.worldenergy.org/documents/wec_nuclear_full_report.pdf. Note, however, that carbon prices in Europe remain volatile and uncertain. For instance, in April of 2010, the price of carbon dropped to approximately $\text{€}15$ per metric tonne. Matthew Karr and Ewa Krukowska, *EU Carbon Pauses after This Month's Surge in Prices and Volume*, BUSINESSWEEK, Apr. 27, 2010, <http://www.businessweek.com/news/2010-04-27/eu-carbon-pauses-after-this-month-s-surge-in-prices-and-volume.html>.

66. WEC REPORT, *supra* note 65, at 20.

67. See Dr. Denis E. Beller, *Atomic Time Machines: Back to the Nuclear Future*, 24 J. LAND RESOURCES & ENVTL. L. 41 (2004).

with new nuclear facilities or by renewing operation of plants slated for shutdown. The report also noted that carbon price increases would enhance the cost effectiveness of nuclear energy. The report appears to have used increased competitiveness of nuclear energy as reason for recommending that the government support companies to invest in capital-intensive nuclear power plant construction projects.⁶⁸ The U.K. government is apparently acting on these recommendations; in 2008, the Cabinet sought to attract investors by offering a series of incremental incentives, including fast track planning and assurances on carbon pricing.⁶⁹

The German government has suspended its deal with the nuclear industry to phase out nuclear power plants over a 32-year period, pending financial negotiations for lengthening the life of nuclear power plants.⁷⁰ The Swedish government has also recommenced nuclear power plant construction, following a vote to remove a ban on nuclear energy imposed by a 1980 referendum.⁷¹

In other countries, including Japan, China, and some in South America and Asia, governments remain undeterred by cost considerations.⁷² As mentioned earlier, these nations view nuclear energy as a central strategy for managing their greenhouse gas emissions without compromising their energy use. Nations such

68. DEP'T OF TRADE AND INDUSTRY, *THE ENERGY CHALLENGE: ENERGY REVIEW REPORT 17*, 113, 124 (2003) (U.K.), available at <http://www.berr.gov.uk/files/file31890.pdf>. See also Peter D. Cameron, *The Revival of Nuclear Power: An Analysis of the Legal Implications*, 19 J. ENVTL. L. 71, 81-82 (2007) (explaining the change in the U.K.'s nuclear policy because of climate change, among other factors).

69. Patrick Wintour, *Cabinet Short-Circuits Obstacles to Building 10 Nuclear Stations*, *GUARDIAN*, Jan. 9, 2008, <http://www.guardian.co.uk/politics/2008/jan/09/uk.world>.

70. WORLD NUCLEAR ASS'N, *NUCLEAR POWER IN GERMANY 4*, (2010) available at <http://www.world-nuclear.org/info/inf43.html>. See also *Merkel Nudges for Nuclear Power Come Back*, *SPEIGEL ONLINE INT'L*, July 7, 2007, <http://www.spiegel.de/international/germany/0,1518,492202,00.html> (reporting on German Chancellor Angela Merkel's support for nuclear energy as an essential element for addressing climate change).

71. Bruno Waterfield, *Sweden to Build New Nuclear Power Stations in Defiance of a 1980 Referendum*, *THE TELEGRAPH*, June 18, 2010, <http://www.telegraph.co.uk/news/worldnews/europe/sweden/7838161/Sweden-to-build-new-nuclear-power-stations-in-defiance-of-a-1980-referendum.html>.

72. *China Offers Argentina Nuclear Power Technology*, *HINDUSTAN TIMES*, July 15, 2010, <http://www.hindustantimes.com/China-offers-Argentina-nuclear-power-technology/Article1-572592.aspx>.

as China may even receive the additional benefit of reduced air pollution from sulfur dioxide and other emissions.⁷³

Clearly, excluding nuclear technology from Joint Implementation (JI) or Clean Development Mechanism (CDM) provisions has not stalled a nuclear energy renaissance. On the contrary, anticipated climate regulation is turning the tide in favor of nuclear energy. Further, while nuclear energy is explicitly excluded under JI and CDM, there are no constraints on Annex I nations generating and trading in emissions credits by substituting domestic fossil fuel use with nuclear energy.⁷⁴

Thus, global nuclear energy expansion may be inevitable in view of climate change. Moreover, such expansion warrants international cooperation, even if nuclear energy is excluded from Kyoto Protocol mechanisms. In a presentation at COP 12 in Nairobi, a U.S. senior climate negotiator included nuclear energy in the United States' international technology cooperation portfolio.⁷⁵ The United States has already been pivotal in promoting nuclear cooperation with several nations, including the United Arab Emirates⁷⁶ and India,⁷⁷ effectively establishing the foundation for building a nuclear energy future.

73. Dong & Hong, *supra* note 44, at 109-110.

74. There is no specific COP decision barring nations from using nuclear energy to reduce their emissions. For Annex I nations that have accepted Kyoto obligations, this implies that they can trade any excess carbon through the emissions trading scheme. Indeed, nuclear energy features prominently in the European Union's plans to foster its emissions trading scheme. See Harri Laurikka & Tina Koljonen, *Emissions Trading and Investment Decisions in the Power Sector—A Case Study in Finland*, 34 ENERGY POLICY 1063-1074 (2006) (discussing how the emissions trading scheme under the Kyoto Protocol as implemented in Europe is promoting investment in nuclear energy in Finland). See also JULIA RENAUD, IEA, EMISSIONS TRADING AND ITS POSSIBLE IMPACTS ON INVESTMENT DECISIONS IN THE POWER SECTOR: IEA INFORMATION PAPER 55-57 (2003), available at <http://www.iea.org/papers/2003/cop9invdec.pdf> (discussing how the emissions trading scheme can foster investment in nuclear energy in Europe).

75. Dr. Harlan L. Watson, *International Technology Cooperation: U.S. View UNFCCC Senior-Level Round-Table Discussion on International Technology Cooperation on Environmentally Sound Technologies: What makes it work?*, UNFCCC (Nov. 14, 2006), http://unfccc.int/files/cooperation_and_support/technology/application/pdf/061204_watson.pdf (noting as one of "United States-Initiated International Technology Partnerships," a "[g]lobal nuclear energy partnership, through which the United States would build consensus on using nuclear energy, while at the same time safeguarding against nuclear proliferation.").

76. *Agreement for Cooperation between the Government of the United States of America and the Government of the United Arab Emirates Concerning Peaceful Uses of Nuclear Energy*, BUREAU OF INT'L SEC. AND NONPROLIFERATION (Jan. 15, 2009), <http://www.state.gov/t/isn/rls/fs/121026.htm>.

V.

THE FOUNDATION FOR NUCLEAR ENERGY HAS
BEEN LAID: INDIA AS AN EXAMPLE

The U.S.-India 2004 Next Steps in Strategic Partnership (NSSP) laid the foundation for international civil nuclear energy cooperation with India.⁷⁸ One of NSSP's goals was to encourage nuclear energy cooperation as a strategy for achieving clean energy-based economic growth in India and globally.⁷⁹ 42 U.S.C. § 2153⁸⁰ required the two nations to sign an agreement as a prerequisite for cooperation, generating much debate.⁸¹ Skepticism about the agreement abounded, particularly because of India's foreign policy on nuclear proliferation; India is one of the few countries that has not signed the Nuclear Non-Proliferation Treaty (NPT).⁸²

Nevertheless, the proposed U.S.-India Civil Nuclear Agreement garnered the adequate support because of India's good non-proliferation record⁸³ and its willingness to open its civil nuclear facilities to IAEA inspection and ratify international agree-

77. See *infra* notes 78-107 & accompanying text (discussing arrangements between the United States and India).

78. Press Release, White House, Joint Statement between President George W. Bush and Prime Minister Manmohan Singh (July 18, 2005), <http://georgewbushwhitehouse.archives.gov/news/releases/2005/07/20050718-6.html>.

79. SHARON SQUASSONI, CONG. RESEARCH SERV., RL 33016, U.S. NUCLEAR COOPERATION WITH INDIA: ISSUES FOR CONGRESS 1-11 (2005), available at <http://fpc.state.gov/documents/organization/50809.pdf>. The NSSP was strengthened when President Bush, in a 2005 joint statement with Prime Minister Singh, announced the creation of a global partnership with India and committed to receiving Congressional approval for civil nuclear cooperation with India. *Id.* at 2.

80. For an overview of U.S. legislative requirements for the United States to cooperate with other countries on nuclear energy, see PAUL K. KERR & MARY BETH NIKITIN, CONG. RESEARCH SERV., RS 22937, NUCLEAR COOPERATION WITH OTHER COUNTRIES: A PRIMER 4-9 (2010), available at <http://fpc.state.gov/documents/organization/137178.pdf>.

81. See, e.g., Dr. Ashley J. Tellis, *South Asia Expert Tells Managing Editor Aziz Hanifa Why the US-India Deal Should Not Fail*, INDIA ABROAD, July 20, 1997, http://www.carnegieendowment.org/files/tellis_india_abroad.pdf (explaining why despite doubts the deal would go through); Sharon Squassoni, *The U.S.'s Catastrophic Deal with India: Power Failure*, NEW REPUBLIC ONLINE (Aug. 3, 2007), <http://www.carnegieendowment.org/publications/index.cfm?fa=view&id=19475> (arguing that the United States would gain little but defense contracts with India).

82. Bernard Gwertzman, *Tough Issues for NPT Review*, COUNCIL ON FOREIGN RELATIONS, (May 3, 2010), http://www.cfr.org/publication/22011/tough_issues_for_npt_review.html#.

83. Dana Dillon & Baker Spring, *Nuclear India and the Non-Proliferation Treaty*, THE HERITAGE FOUND. (May 18, 2006), <http://www.heritage.org/research/reports/2006/05/nuclear-india-and-the-non-proliferation-treaty> (noting that despite international sanctions, India did not share its nuclear technology).

ments on nuclear liability.⁸⁴ More importantly for this discussion, climate change was also pivotal. Supporters argued that international nuclear cooperation was essential for the development of a country that rejected legally binding emissions reduction obligations and faced a high cost of natural gas.⁸⁵

Thus, opposition in the United States, India, and around the world notwithstanding, the Nuclear Supplier's Group (NSG) removed controls on nuclear supply to India⁸⁶ and the legislative bodies of both nations approved the U.S.-India Civil Nuclear Agreement.⁸⁷ As part of the agreement, the Indian government also submitted its civil nuclear facility to external scrutiny under the Safeguards Agreement to IAEA,⁸⁸ overcoming opposition from members of the Parliament.⁸⁹ The conclusion of the U.S.-India deal has facilitated broader international cooperation, and India has since then steadily expanded its international cooperation with other nations.

To date, India has concluded bilateral nuclear agreements or committed to cooperation with several nations, including France,⁹⁰ Russia,⁹¹ Canada,⁹² Argentina,⁹³ the United King-

84. Dennis M. Gormley & Lawrence Scheinman, *Implications of Proposed India-U.S. Nuclear Cooperation*, NUCLEAR THREAT INITIATIVE, July 2005, http://www.nti.org/e_research/e3_67a.html.

85. David G. Victor, *The India Nuclear Deal: Implications for Global Climate Change, Testimony before the U.S. Senate Committee on Energy and Natural Resources*, COUNCIL ON FOREIGN RELATIONS (July 18, 2006), http://www.cfr.org/publication/11123/india_nuclear_deal.html.

86. *India Joins Nuclear Club, Gets NSG Waiver*, NDTV.COM (New Delhi) (Sept. 06, 2008), <http://www.ndtv.com/convergence/ndtv/story.aspx?id=NEWEN20080064332>.

87. Henry J. Hyde, United States-India Peaceful Atomic Energy Cooperation Act of 2006, H.R. 5682, 109th Cong. (2006). See also John R. Crook, *Congress Approves Nuclear Cooperation Agreement with India; Agreement Signed and Brought into Force*, 103 AM. J. INT'L L. 163 (2009); *Recent Legislation*, 120 HARV. L. REV. 2020, 2020 (2007), available at <http://hrl.rubystudio.com/media/pdf/USIPAECA.pdf>.

88. Somini Sengupta, *Indian Government Survives Confidence Vote*, N.Y. TIMES, July 23, 2008, http://www.nytimes.com/2008/07/23/world/asia/23india.html?_r=2&ref=world&oref=slogin.

89. IAEA, NUCLEAR VERIFICATION: THE CONCLUSION OF SAFEGUARDS AGREEMENTS AND ADDITIONAL PROTOCOLS, AN AGREEMENT WITH THE GOVERNMENT OF INDIA FOR THE APPLICATION OF SAFEGUARDS TO CIVILIAN NUCLEAR FACILITIES 1-27 (2008) [hereinafter *Safeguards Agreement*], available at http://www.isis-online.org/publications/southasia/India_IAEA_safeguards.pdf.

90. Pranab Dhal Samanta, *India, France Ink Nuclear Deal, First After NSG Waiver*, INDIAN EXPRESS, Oct. 1, 2008, <http://www.indianexpress.com/story-print/368048> (noting the agreement recognizes India's right to reprocess nuclear fuel, but not its right to buy from France enrichment and reprocessing technology). More recently, India concluded deals with France and its nuclear company Areva during Nicolas Sarkozy's visit to the subcontinent. *India-France Sign Agreement on Nuclear*

dom,⁹⁴ Kazakhstan,⁹⁵ Namibia,⁹⁶ and Mongolia.⁹⁷ Negotiations with Japan are less expedient because of Japan's insistence that India first commit to international non-proliferation obligations.⁹⁸ Germany is also considering nuclear cooperation with

Civil Cooperation, NDTV.COM, <http://www.ndtv.com/article/india/india-france-sign-agreement-on-civil-nuclear-cooperation-70721> (last visited Dec. 6, 2010).

91. *India, Russia Sign Nuclear Deal*, TIMES OF INDIA, Dec. 7, 2009, <http://timesofindia.indiatimes.com/articleshow/5311267.cms?prtpage=1>; Nirmala George, *Putin in Deal to Build Nuclear Reactors for India*, THE GUARDIAN, Mar. 12, 2010, <http://www.guardian.co.uk/world/2010/mar/12/russia-india-nuclear-reactor-deal/print> (stating that Russia plans to build twenty nuclear reactors in the country and has also strengthened its arms supply ties with India).

92. Press Release, Ind. Ministry of External Affairs, Joint Statement during the Visit of Prime Minister Dr. Manmohan Singh (June 27, 2010), available at <http://india.gov.in/outerwin.php?id=http://meaindia.nic.in/>; T.K. Arun, *India and Canada Sign Civilian Nuclear Deal*, ECON. TIMES, Jan. 29, 2010, <http://economictimes.india.com/articleshow/6103780.cms?prtpage=1> (stating the two nations entered into the Agreement for Cooperation in Peaceful Uses of Nuclear Energy); TCA Srinivasa Raghavan, *India, Canada Sign Civil Nuclear Deal*, THE HINDU, June 28, 2010, <http://www.thehindu.com/news/national/article490077.ece?css=prints>.

93. Press Release, Ind. Ministry of External Affairs, Joint Statement by India and Argentina on the Visit of President of the Argentine Republic to India, Towards a Strategic Partnership (Oct. 14, 2009), available at <http://india.gov.in/outerwin.php?id=http://meaindia.nic.in/>; Huma Siddiqui, *Nuclear Deal to Be Sealed with Argentina during M.O.S. Visit*, FIN. EXPRESS, May 24, 2010, <http://www.financialexpress.com/news/nuclear-deal-to-be-sealed-with-argentina-during-mos-visit/622665/>.

94. Press Release, Ind. Ministry of External Affairs, Joint Declaration by India and the United Kingdom on Civil Nuclear Cooperation (Feb. 11, 2010), available at <http://www.dae.gov.in/press/indoukjtdec.htm>; UK, *India Sign Civil Nuclear Deal*, ENERGY BUS. REV., Feb. 15, 2010, http://nuclear.energy-businessreview.com/News/uk_india_sign_civil_nuclear_deal_100215/; Avril Ormsby, *UK, India Sign Civil Nuclear Accord*, REUTERS, Feb. 15, 2010, <http://www.reuters.com/article/idUSTRE61C21E20100213> (under the agreement the United Kingdom may construct nuclear facilities in India).

95. Press Release, Ind. Ministry of External Affairs, Joint Declaration on Strategic Partnership between India and Kazakhstan (Jan. 24, 2009), available at <http://india.gov.in/outerwin.php?id=http://meaindia.nic.in/> (the two nations have agreed on nuclear cooperation, including mining of uranium).

96. *India, Namibia Inks Uranium Supply Deal*, COMMODITY ONLINE (Sept. 1, 2009), <http://www.commodityonline.com/news/India-Namibia-ink-uranium-supply-deal-20821-3-1.html> (under the agreement Namibia has agreed to supply uranium to India).

97. Press Release, Ind. Ministry of External Affairs, Joint Declaration on the Comprehensive Partnership between India and Mongolia (Sept. 14, 2009), available at <http://india.gov.in/outerwin.php?id=http://meaindia.nic.in/>.

98. Jyoti Malhotra, *India Japan Working on Nuclear Deal to Boost 123 Agreement*, BUS. STANDARD, May 10, 2010, <http://www.business-standard.com/india/storypage.php?autono=394323> (reportedly the deal is stalled because of Japan seeks reassurance on India's international commitment to NPT and to the Comprehensive Test Ban Treaty).

India.⁹⁹ Additionally, the United States recently concluded an agreement on a reprocessing arrangement.¹⁰⁰

The U.S.-India civilian nuclear deal, which India had identified in its 2006 Integrated Energy Policy (IEP) as a critical agreement to achieve national nuclear power development,¹⁰¹ is clearly a coup for the Indian government. With the removal of NSG sanctions on the heels of the agreement, India can now import both high quality uranium at internationally competitive prices and technology for utilizing its abundant domestic thorium.¹⁰² The Nuclear Power Corporation India Limited (NPCIL), a government-owned company that operates under the supervision of the Department of Atomic Energy (DAE), is already urging domestic manufacturers to produce reactors in India so as to make technology transfer under the agreements cost effective.¹⁰³ To encourage such technology transfer, NPCIL has acknowledged the importance of intellectual property protection of designs shared by foreign nuclear companies with Indian manufacturers.¹⁰⁴ This commitment is especially crucial given the United States' refusal at Cancun to compromise intellectual property protection in transferring arguably climate-friendly technol-

99. Shyam Ranganathan, *Germany Keen on Civil Nuclear Cooperation*, THE HINDU, Jan. 11, 2010, <http://www.hindu.com/2010/01/14/stories/2010011460681100.htm> (reporting Germany's willingness to cooperate in light of India's "impeccable" non-proliferation record).

100. Arrangements and Procedures Agreed Between the Government of the United States and the Government of India, Pursuant to Article 6(iii) of Their Agreement for Cooperation Concerning Peaceful Uses of Nuclear Energy, U.S.-India, Mar. 29, 2010, DEP'T ST. BULL., <http://www.state.gov/p/sca/rls/139194.htm>; see also Mark Hibbs, *Moving Forward on the U.S.-India Nuclear Deal*, CARNEGIE ENDOWMENT FOR INT'L PEACE (Apr. 5, 2010), <http://carnegieendowment.org/publications/index.cfm?fa=view&id=40491> (discussing the implications of the agreement).

101. INDIA PLANNING COMM'N, INTEGRATED ENERGY POLICY: REPORT OF THE EXPERT COMMITTEE xxii (2006) [hereinafter IEP REPORT], available at http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf ("If the recent agreement with the U.S. translates into a removal of sanctions by the nuclear supplier's group, possibilities of imports of nuclear fuels as well as power plants should be actively considered so that nuclear development takes place at a faster pace.").

102. *Id.* at 35 (reporting that uranium in India costs three times than uranium in the international market because of the poor quality of the ore). See also Anil Kakodkar, Chairman, Atomic Energy Comm'n (India), Speech at the Indian Atomic Industrial Forum: Managing New Nuclear Power Paradigm (Aug. 14, 2008), http://www.npcil.nic.in/pdf/Chairmans_speech_IAIF_14_8_2008.pdf (noting that India possesses abundant thorium supply).

103. *Id.*

104. Kakodkar, *supra* note 102, at 26-27 (the publication is a transcript of a speech delivered by the Chairman of the Atomic Energy Commission at the Indian Atomic Industrial Forum on Aug. 14, 2008).

ogy.¹⁰⁵ India's civilian nuclear program is certainly expansive and ambitious.

However, to fully optimize the benefits of nuclear energy in reducing its emissions, India must import 8,000 MW of light water reactors (LWR) with fuel for the next ten years (from 2006),¹⁰⁶ operate fast breeder reactor technologies, open new uranium mines to fuel additional pressurized heavy water reactors, assimilate imported LWR technology and develop advanced heavy water reactors for utilizing thorium by 2020.¹⁰⁷ Such rapid expansion, to the extent that it occurs, will have significant environmental impacts. Further, to achieve the alleged climate benefits, nuclear energy use must be complemented by reduced fossil fuel use and a stable nuclear policy. Both international and Indian legal and policy preparation will test the legitimacy of nuclear energy as an environmentally sound solution to mitigate climate change.

VI.

ENGAGING INDIA IN NUCLEAR ENERGY SHOWS LOCAL AND GLOBAL ENVIRONMENTAL PROBLEMS

While security or proliferation concerns regarding India's nuclear program have received significant attention,¹⁰⁸ the environ-

105. Lisa Friedman & Climatewire, *Future of Kyoto Protocol in Doubt as Climate Talks Enter Final Day*, SCIENTIFIC AM., Dec. 10, 2010, <http://www.scientificamerican.com/article.cfm?id=future-of-kyoto-protocol-in-doubt> (noting that the issue of intellectual property rights would not be resolved in Cancun). See also Catherine Saez, *UN Climate Talks Find Make-Do Solution; IP Rights Dismissed*, INTELLECTUAL PROP. WATCH BLOG (Dec. 14, 2010, 5:45 PM), <http://www.ip-watch.org/weblog/2010/12/14/climate-change-talks-find-make-do-solution-till-next-year-ip-rights-dismissed>.

106. See IEP REPORT, *supra* note 101, at 37 tbl.3.4.

107. *Id.*

108. First, it is unlikely that the government of India will adopt policies that will lead to proliferation, because from its own security perspective India stands to gain very little from sharing its technology with others nations such as Pakistan or Iran. Second, most of its immediate competitors such as China already possess nuclear technology. However, proliferation could occur during transport or from any leaks in companies. See GEORGE PERKOVICH, CARNÉGIE ENDOWMENT FOR INT'L PEACE, *FAULTY PROMISES: THE U.S.-INDIA NUCLEAR DEAL 5-7 (2005)*, available at <http://carnegieendowment.org/files/PO21.Perkovich.pdf>. Further, cooperation with India could impair other strategies of the United States, notably sanctions against Iran. Presently, India has not imposed sanctions on Iran, in all likelihood because of its ongoing negotiations with Iran for natural gas imports. See *IPI Pipeline: India to Resume Talks with Iran*, TIMES OF INDIA, July 12, 2010, <http://timesofindia.india.com/india/IPI-pipeline-India-to-resume-talks-with-Iran/articleshow/6159338>. cms for discussion on the proposed Iran-Pakistan-India (IPI) Pipeline. Jayanth Ja-

mental risks are less explored, even though at least two environmental shortcomings are apparent: 1) domestic and international legal uncertainties undermine the environmental promise of civilian nuclear energy as a climate mitigation tool;¹⁰⁹ and 2) transferring nuclear technology to India without considering environmental issues, such as a waste management or liability regime, create future environmental governance challenges, both domestic and international, which will be heightened by poor international regulatory mechanisms. These environmental concerns indicate that ignoring nuclear energy within the climate regime is a poor environmental governance strategy.

A. *Increasing Nuclear Energy Will Not Solve India's Short Term Emissions Problem Because of Domestic and International Regulatory and Administrative Uncertainties*

To optimize the benefits of nuclear energy, the Indian government must undertake substantial administrative and regulatory reforms in its power sector. Recent amendments to the Electricity Act and its mandate to State Electricity Boards¹¹⁰ have not filled gaps in power distribution, which are attributed to public sector operation.¹¹¹ However, liberalization of the power sector may not be a viable option. Indians will likely resist privatization, especially because of India's experience with the Enron-Dabhol project,¹¹² which was India's failed attempt to attract foreign investment in the energy sector. The Maharashtra State Electricity Board entered into an agreement with the Dhabol Power Corporation, in which (then) Texas-based Enron Corporation had a majority share, to construct and operate power plants

cob, *India against Iran Sanctions*, HINDUSTAN TIMES, Apr. 12, 2010, <http://www.hindustantimes.com/India-against-Iransanctions/Article1-530143.aspx>.

109. Despite India's apparently new willingness at the COP 14 in Cancun to cooperate in an international climate regime, it is unlikely that the government will commit to stringent emissions reduction goals. See Lahiri, *infra* note 136.

110. See Sanjay José Mullick, *Power Game in India: Environmental Clearance and the Enron Project*, 16 STANFORD ENV'T L. J. 256, 262-66 (1997) (explaining amendments to the Indian electricity legislation to facilitate foreign investments).

111. IEP REPORT, *supra* note 101, at 47.

112. For details of the background to the project, see Jeswald W. Salacuse, *Renegotiating International Project Agreements*, 24 FORDHAM INT'L L.J. 1329, 1343-50 (2001) (explaining both the background and the deal that was entered between Enron and the Government of Maharashtra with the assistance of the governments of India and the United States, as well as GE, Betchel, Bank of America, and the World Bank).

and supply electricity.¹¹³ The several mishaps that followed, including environmental issues, breach of contract claims by both parties, and the blackout suffered by nearly 200 million people, clearly marred India's first power sector liberalization effort.¹¹⁴ Moreover, the reasons for Dhabol's failure, including change in administration, environmental clearances, and dispute over the high costs of power leading to defaults in payment, have not changed so significantly as to instill public confidence in privatization of the energy sector.¹¹⁵

A nation-wide strike protesting the government's removal of diesel subsidies per IEP's recommendation¹¹⁶ indicates continuing anti-liberalization sentiments. Although the government remained steadfast in its decision, the strike caused a nearly U.S. \$600 million loss. The government's action could also cost it its re-election, especially since the opposition party, BJP, was instrumental in organizing the strike.¹¹⁷ Opposition parties are vigorously challenging the fuel hike,¹¹⁸ illustrating that for India prioritizing the power sector will not only be a pragmatic, but also political decision.

113. See Tony Allison, *Enron's Eight-Year Power Struggle in India*, ASIA TIMES, Jan. 18, 2001, <http://www.atimes.com/reports/ca13ai01.html>.

114. *Id.*

115. *Id.* at 1350-53; Preeti Kundra, Note, *Looking Beyond the Dabhol Debacle*, 41 VAND. J. TRANSNAT'L L. 907, 916-20 (2008).

116. Amy Kazmin, *Strike Drags India to a Halt*, FIN. TIMES, July 5, 2010, <http://www.ft.com/cms/s/0/639d195e-87f6-11df-a4e7-00144feabdc0.html>; Krishna Pokharel, *Indian Opposition Stages Strike on Fuel-Price Rise*, WALL ST. J. ONLINE, July 5, 2010, <http://online.wsj.com/article/SB10001424052748703620604575348812439539970.html>. While there is some skepticism that the strike was organized by wholesale dealers owned by politicians who received sidekicks from subsidies and not to protect the poor against increases, the strike demonstrates that the challenges of liberalizing the energy sector persists. Bhamy V. Shenoy, *The Real Reasons behind India's Reluctance to Liberalize Petroleum Prices*, GLOBAL SUBSIDIES INITIATIVE (May 2010), http://www.globalsubsidies.org/files/assets/subsidy_watch/sw_38_may_2010.pdf.

117. *Nationwide Strikes Test Indian Government's Resolve over Gasoline Price Deregulation*, IHS GLOBAL INSIGHTS (July 6, 2010), <http://www.ihsglobalinsight.com/SDA/SDADetail18915.htm>; *Advani Hopes Strike Would Silence Opposition's Critics*, EXPRESS INDIA, July 6, 2010, <http://www.expressindia.com/latest-news/Advani-hopes-strike-would-silence-Oppositions-critics/642814/>.

118. *Unrelenting Opposition Parties Rock Parliament*, DECCAN HERALD, July 27, 2010, <http://www.deccanherald.com/content/84167/unrelenting-opposition-parties-rock-parliament.html> (reporting that the opposition to fuel hike disrupted normal proceedings in the Parliament).

Both the Dabhol case¹¹⁹ and the strike provide important lessons in assessing the future of nuclear energy for several reasons. First, they demonstrate that the government must take into account potentially uncertain outcomes as part of its decision-making process. Thus far, two public-sector companies—Nuclear Power Corporation of India Limited and Bharatiya Nabhikiya Vidyut Nigam Limited— have retained control over the construction and operation of nuclear power plants under the supervision of the Department of Atomic Energy (DAE).¹²⁰ However, under the new agreements, several foreign and domestic entities can transact a wide range of activities from nuclear fuel supplies, technology transfers, and operation of facilities to the importation of nuclear facilities under a new DAE regulation.¹²¹ This is a far-reaching development, because although the DAE retains control by stipulating that all transactions require prior DAE authorization and are subject to regulatory supervision of DAE,¹²² manufacturers and importers will for the first time serve as intermediaries in transactions between public sector companies and foreign suppliers.¹²³ This limited liberalization of nuclear transactions will subject materials or equipment to market pricing.¹²⁴ There is no indication that such liberalization can reduce costs in practice. It therefore remains unclear

119. Although the parties to the case eventually settled, the case illustrates that economic miscalculations can lead to costly project failures as in this case where the government was unable to buy energy at promised prices due to uncertain demand. KENNETH HANSEN, ROBERT C. O'SULLIVAN & W. GEOFFREY ANDERSON, *THE DABHOL POWER PROJECT SETTLEMENT, WHAT HAPPENED? AND HOW?* 5 (2005), available at http://www.chadbourne.com/files/Publication/a5aa1e52-4285-4bb5-87e67201123895a0/Presentation/PublicationAttachment/352f8f09-ae96-40fc-a293720d0b8f0ca8/Dabhol_InfrastructureJournal12_2005.pdf.

120. *Nuclear Power in India*, WORLD NUCLEAR ASS'N, <http://www.world-nuclear.org/info/inf53.html> (last visited Feb. 12, 2011); BHARATIYA NABHIKIYA VIDYUT NIGAM LTD., <http://www.bhavini.nic.in/> (last visited Feb. 12, 2011).

121. *Guidelines for the Implementation of Arrangements for Cooperation Concerning Peaceful Uses of Atomic Energy with other Countries, Resolution No. 1/10/8/2009-ER*, DEP'T OF ATOMIC ENERGY, GOV'T OF INDIA (June 4, 2010), http://www.dae.gov.in/sectt/Résolution_English.pdf [hereinafter DAE GUIDELINES]. See also Kakodkar, *supra* note 102 (explaining the various aspects of successfully implementing the civil nuclear arrangements).

122. DAE GUIDELINES, *supra* note 121, ¶¶ 5 and 14, respectively. The guidelines also provide for details regarding the application and establish reporting requirements. *Id.* ¶¶ 9, 11-12.

123. See Kakodkar, *supra* note 102.

124. See, e.g., Erwann O. Michel-Kerjan & Debra K. Decker, *The Economics of Nuclear Energy Markets and the Future of International Security* 25-30 (The Wharton School, University of Pennsylvania, Working Paper No. 2008-01-08, 2008), available at http://opim.wharton.upenn.edu/risk/library/WP2008-01-08,EMK,DD_ENEM.pdf

whether nuclear power will be cost effective and whether the public sector companies can profitably sell electricity generated from these power plants. If the government fails to consider these aspects, it will fuel a repetition of the Dhabol fiasco. It will also fuel public outrage that may not only warrant a change in administration, but also a reversal of policies for political reasons.

Regulatory uncertainties regarding nuclear liability can also slow down or even undermine India's nuclear program. The current administration, which won an uphill battle in receiving approval for the U.S.-India Civil Nuclear Agreement,¹²⁵ failed to sway the Parliament to support its originally proposed Civil Liability for Nuclear Damage Bill, 2010 (the Bill),¹²⁶ which was essential for the government to fructify its agreement with the United States.¹²⁷ The original Bill, which was modeled after the U.S. Price Anderson Act, not only extended liability to nuclear plant operators, but also capped their liability.¹²⁸ The amended Bill extends liability to suppliers and has also increased the cap amount.¹²⁹ The United States has criticized the amended bill for departing from international protocol in allowing supplier liabil-

(noting the deregulation of the energy market and the operation of the uranium market).

125. In light of opposition to India submitting to the Safeguard's Agreement, Prime Minister Singh threatened to resign. See Sheela Bhat, *PM Wants to Quit over Nuclear Deal*, REDIFF INDIA ABROAD, June 20, 2008, <http://www.rediff.com/news/2008/jun/19pm.htm> (discussing that in light of opposition to India submitting to the Safeguard's Agreement, Prime Minister Singh threatened to resign).

126. THE CIVIL LIABILITY FOR NUCLEAR DAMAGE BILL, NO. 19, PRS LEGISLATIVE RESEARCH (INDIA), CTR. FOR POL'Y RESEARCH 35-36, <http://www.prsindia.org/uploads/media/Nuclear/Civil%20Nuclear%20Liability%20Bill%202010.pdf> [hereinafter India Civil Nuclear Liability Bill].

127. Henry Sokolski, *Insuring India's Nuclear Deal*, WALL ST. J., Apr. 19, 2010, <http://online.wsj.com/article/SB10001424052748704508904575192793726876892.html> (explaining the bone of contention revolves around limits placed on third party liability for nuclear incidents and a \$100 million cap on liability). U.S. nuclear vendors may not enter into agreements absent a nuclear liability law.

128. See Lahiri, *infra* note 136.

129. See Ronak D. Desai, *Nuclear Liability Issue Remains Key Challenge as Obama Visits India*, HARV. NAT'L SEC. J., (Nov. 6, 2010), <http://www.harvardnsj.com/2010/11/nuclear-liability-issue-remains-key-challenge-as-obama-visits-india/>. Clause 17 of the amended Bill provides the operator "right to recourse" after operator pays for compensation if there is a contract to that effect with the supplier, the supplier was willfully or grossly negligent, and there is an intentional action or omission. See THE CIVIL LIABILITY FOR NUCLEAR DAMAGE BILL 7-8 (2010), available at <http://prsindia.org/uploads/media/CNLD.Amendments.pdf>.

ity, even if under exceptional conditions.¹³⁰ The amendments were, however, one of many essential compromises required for the current administration to gain the opposition party's support.¹³¹

However, the Bill may not only affect nuclear arrangements with U.S. firms. While only U.S. legislation required India to adopt a nuclear liability law as a precondition for nuclear technology transactions, the Bill may also give other nations pause. For example, Russia has reportedly expressed concerns about constructing following the passage of the amended nuclear liability Bill.¹³² It is therefore unlikely that international nuclear energy transactions will proceed as smoothly or quickly as initially planned. Consequently, nuclear energy growth in India may not contribute to timely emissions reductions.

Uncertainties regarding the legal framework for emissions reduction post-2012 also undermine the environmental merits of India's nuclear program. At COP 15 in Copenhagen, nations agreed to stabilize global temperature increases at two degrees Celsius.¹³³ However, even though signatories to the Copenhagen Accord submitted emissions reduction goals as agreed,¹³⁴ their commitment cannot be measured against a clear benchmark regarding the amount of emissions nations must necessarily reduce to mitigate climate change or even to achieve the Copenhagen Accord's goals.

Although the Cancun agreement adopted at COP 16 has brought the Copenhagen Accord into the UNFCCC process, the

130. LOK SABHA, BULLETIN—PART I BRIEF RECORD OF PROCEEDINGS 13-15 (2010), available at <http://164.100.47.132/bull1/15/V/25.8.2010.pdf>; see also *India Parliament Passes Civil Nuclear Power Bill*, BBC NEWS, Aug. 25, 2010, <http://www.bbc.co.uk/news/world-south-asia-11084256>.

131. The amended Bill has also increased the amount of operator liability and limits operation liability to plants operated by the government. For an overview of amended provisions, see generally PRS LEGISLATIVE RESEARCH, AMENDMENTS TO THE CIVIL LIABILITY FOR NUCLEAR DAMAGE BILL (2010), available at <http://prsindia.org/uploads/media/Nuclear/Comparison%20of%20the%20Bill.%20Standing%20Committee%20Report%20and%20Amendments%20introduced.pdf>.

132. See *'Flawed' Liability Bill Threatens Indo-US Nuclear Deal: Expert*, TIMES OF INDIA, Sept. 1, 2010, <http://timesofindia.indiatimes.com/india/Flawed-liability-bill-threatens-Indo-US-nuclear-deal-expert/articleshow/6471824.cms#ixzz18ZAHayJ4>.

133. See Copenhagen Accord, *supra* note 45, at 5.

134. *Appendix II-Nationally Appropriate Actions of Developing Country Parties*, UNFCCC, <http://unfccc.int/home/items/5265.php> (last visited Nov. 4, 2010) (listing all the submissions deposited with the UNFCCC Secretariat by signatories of the Copenhagen Accord).

time period for establishing emissions reduction goals remains uncertain.¹³⁵ This aspect is especially important for India, whose Environment Minister's position at Cancun favoring emissions reduction commitment has been criticized as compromising national interest even by environmental activists;¹³⁶ indeed the Indian Prime Minister has reassured the public by asking them not read too much into the minister's statements in Cancun.¹³⁷ Moreover, Cancun's many successes, including the creation of adaptation funds, should not detract attention from the serious international ambiguities regarding the future of emissions reduction within the Kyoto framework.¹³⁸ Japan and Russia, for instance, have explicitly rejected any binding emissions reduction obligation unless all major emitters join the new agreement.¹³⁹ These legal uncertainties can hamper timely achievement of the steep emissions reduction goals identified by IPCC for mitigating climate change.

The WEO predicts that even if nations pursue alternative policies, energy-related emissions will only peak by 2020,¹⁴⁰ and that although accelerated deployment of both nuclear and carbon capture and storage technologies could help reduce emissions by 2030, neither may be timely used because of policy hurdles.¹⁴¹ Similarly, IEP does not anticipate India's nuclear program to be-

135. See, e.g., Daniel Bodansky, *Cancun Can't*, OPINIO JURIS (Dec. 12, 2010, 4:49 AM), http://opiniojuris.org/2010/12/12/cancun-can/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+opiniojurisfeed+%28Opinio+Juris%29.

136. Tripti Lahiri, *What Did Jairam Ramesh Say at Cancun*, WALL ST. J., Dec. 10, 2010, <http://blogs.wsj.com/indiarealtime/2010/12/10/what-did-jairam-ramesh-say-at-cancun/>; see also *Jairam Ramesh 'Built Bridges' In Cancun Climate Talks*, HINDUSTAN TIMES, Dec. 12, 2010, http://www.hindustantimes.com/Jairam-Ramesh-built-bridges-in-Cancun-climate-talks/Article1-637557.aspx#disqus_thread; *Jairam Ramesh, Activists Differ over India's Cancun Gains*, SIFY NEWS, Dec. 12, 2010, available at <http://www.sify.com/news/jairam-ramesh-activists-differ-over-india-s-cancun-gains-news-national-kmmuEneDDfi.html>.

137. *Don't Read Too Much into Jairam Ramesh's Statement at Cancun: PM*, TIMES OF INDIA, Dec. 10, 2010, <http://timesofindia.indiatimes.com/India/Dont-read-too-much-into-Jairam-Rameshs-statement-at-Cancun-PM/articleshow/7079607.cms#ixzz18aVciiV6>.

138. For an overview of the Cancun agreement and its silence on the Kyoto Protocol, see generally Richard Stavins, *What Happened (and why): An Assessment of the Cancun Agreements*, BELFER CTR., Dec. 10, 2010, <http://belfercenter.ksg.harvard.edu/analysis/stavins/?p=876>.

139. Suzanne Goldenberg, *Cancun Climate Change Conference: Russia Will Not Renew Kyoto Protocol*, THE GUARDIAN, Dec. 10, 2010, <http://www.guardian.co.uk/environment/2010/dec/10/cancun-climate-change-conference-kyoto>.

140. IEA, *WORLD ENERGY OUTLOOK 191*, 191 (2007) [hereinafter WEO 2007], available at http://www.iea.org/textbase/nppdf/free/2007/weo_2007.pdf.

141. *Id.* at 210.

come effective before 2050.¹⁴² Coal use is also expected to decline slowly, dropping only to 61% from 72% by 2031-32.¹⁴³ IEP also recommends that the Indian government not accept any treaty obligations, reasoning that carbon capture and storage (CCS) technology, as well as nuclear energy, will automatically bring down greenhouse gas emissions.¹⁴⁴ Secretary Chu's statement in a recent hearing on CCS specifically underlined the fact that Australia, China, India, and the United States will not turn away from coal.¹⁴⁵

This combination of legal ambiguity regarding emissions reduction means that nations will not be able to achieve the Intergovernmental Panel on Climate Change's (IPCC) target of stabilizing greenhouse gas emissions at 445-490 ppm by ensuring that CO₂ equivalent emissions peak by 2015 (energy-related CO₂ must peak by 2012) and reduce by up to 85% below 2000 levels by 2050.¹⁴⁶ Consequently, as predicted by WEO, temperature increases will likely outpace emissions reduction.¹⁴⁷ Therefore, absent a reliable and well-coordinated international and domestic legal framework on nuclear energy and emissions reduction, nuclear energy is not a panacea for climate mitigation.

B. *Transferring Nuclear Technology to India Sets the Stage for Future Environmental Issues*

Nuclear energy development also increases non-climate related environmental and safety risks, but key nuclear agreements pay lip service to these risks. For instance, a recent agreement between the United States and India on reprocessing spent fuel merely requires the government of India "to follow best practices, as established in its national regulations, for minimizing the impact of the environment which may arise from the operation of the Facility."¹⁴⁸

142. IEP REPORT, *supra* note 101, at xxii.

143. *Id.*

144. *Id.* at 136.

145. Richard M. Jones, *Energy Secretary Appears before House Appropriators*, FYI: AIP BULLETIN OF SCI. POL'Y NEWS (Jun. 9, 2009), <http://www.aip.org/fyi/2009/073.html>.

146. WEO 2007, *supra* note 140, at 205.

147. *Id.* at 206 tbl5.4 (providing data on emissions and associated increases in temperature).

148. Agreement for Cooperation Concerning Peaceful Uses of Nuclear Energy, US-India, art. 6(iii), Dec. 6, 2008, <http://www.dae.gov.in/press/indousrepr.doc>.

However, India's national regulation is nascent, and the government has not yet established any best practices in this regard. Waste management rules best illustrate the problem. A 1987 Atomic Energy (Safe Disposal of Radioactive Wastes) Rule¹⁴⁹ that governs waste management does not designate any particular area for use as a waste storage site, unlike the U.S. Nuclear Waste Policy Act of 1982.¹⁵⁰ It only requires prior authorization from a "competent authority," who can decide what constitutes an appropriate site.¹⁵¹

While such basic legislation may have been sufficient to deal with the small quantities of waste that India's fledgling nuclear plants probably produced, it would be dangerous to provide such discretionary authority to dispose of large quantities of waste, including highly toxic plutonium from spent fuel reprocessing that will be produced when India implements its new nuclear energy program.¹⁵² While there is data on the amount of emissions reduction from use of nuclear energy,¹⁵³ there appears to be no data either on how much waste will be generated or how the government plans to dispose of the waste in a densely populated country.

The DAE certainly does not have an impeccable waste management or safety record, as proven by reports of leaked uranium found in water samples.¹⁵⁴ Indian scientists opposed to new power plant construction suspect that the government has underplayed environmental and safety concerns.¹⁵⁵ Their con-

149. Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987, Gen. S.R. & O. 125 (India), available at <http://www.dae.gov.in/rules/waste.pdf> [hereinafter Indian Atomic Energy Waste Rules].

150. 42 U.S.C. §§ 10101-10108 (1982). NWSA designates Yucca Mountain as a repository site for nuclear waste.

151. See Indian Atomic Energy Waste Rules, *supra* note 149, § 2(vii) (discussing where the competent authority not only reviews applications for waste disposal, but also determines what constitutes radioactive waste and how much can be disposed at a site).

152. K.R. Rao, *Radioactive Waste: The Problem and its Management*, 81 CURRENT SCIENCE 1534, 1540 (2001), available at <http://www.ias.ac.in/currsci/dec252001/1534.pdf>.

153. Copenhagen Accord, *supra* note 45.

154. Yudhvir Rana, *Action on 1995 Study Could've Stopped Punjab Poisoning*, TIMES OF INDIA, June 18, 2010, <http://epaper.timesofindia.com/Default/Scripting/ArticleWin.asp?From=Archive&Source=Page&Skin=TOINW&BaseHref=CAP/2010/06/18&PageLabel=15&EntityId=Ar01507&ViewMode=HTML&GZ=T>.

155. *N-Power Plants Plan Draw Flak*, HINDU BUSINESS LINE, July 2, 2010, <http://www.thehindubusinessline.com/2010/07/03/stories/2010070352501000.htm>; Gopal Krishna, *Mayapuri Radiation Case: Accident Level on International Nuclear Event Scale (INES) Not Revealed*, MYNEWS.IN, Apr. 10, 2010, <http://www.mynews.in/>

cerns are hardly misplaced when one considers a recent accident in New Delhi, in which several scrap metal workers were exposed to radioactive waste suspected to have originated from abroad.¹⁵⁶ This incident has also sparked fear about trade in nuclear materials, particularly spent fuel.¹⁵⁷ On a positive note, the incident has resulted in public interest litigation before the Delhi High Court, and the court has issued notices to the Ministry of Environment and Forests, Directorate General of Foreign Trade, and the DAE to provide information about any permanent mechanisms to screen radioactive waste (Mayapuri case).¹⁵⁸ The Mayapuri case may lead to more stringent regulation, depending on the outcome.

The Mayapuri case also points to regulatory and administrative gaps in regulating nuclear materials. Regulating radioactive waste in India requires coordination between all concerned agencies—the Atomic Energy Regulatory Board, the Atomic Regulatory Commission, and the Ministry of Environment and Forests; the latter primarily for deciding on environmental clearance matters.¹⁵⁹ However, these agencies are inadequately linked.¹⁶⁰ Further, in its urgency to accelerate international nuclear trade, the government appears to be ignoring these gaps in its nuclear waste management mechanisms and has not been transparent when promoting nuclear energy. In his statement before the “Lok Sabha” or the People’s House of the Indian Parliament

News/Mayapuri_Radiation_Case_Accident_level_on_International_Nuclear_Event_Scale_(INES)_not_revealed_N45205.html (discussing that in the Mayapuri case, the government detected and claimed to have “sanitized” the radioactive waste before it reached the market, but this was not true).

156. Rahul Tripathi & Risha Chitlangia, *Wastes Land*, TIMES OF INDIA, Apr. 24, 2010, <http://timesofindia.indiatimes.com/india/Wastes-Land/articleshow/5851900.cms>.

157. Indian Atomic Energy Waste Rules, *supra* note 149.

158. *Court Poser over Radioactive Waste*, THE HINDU, July 8, 2010, <http://www.hindu.com/2010/07/08/stories/2010070859600400.html>.

159. The scope of the duties of each of these agencies regarding nuclear energy is available at GOVERNMENT OF INDIA, ATOMIC ENERGY REGULATORY BOARD, <http://www.aerb.gov.in/> (last visited Apr. 23, 2011); GOVERNMENT OF INDIA, ATOMIC ENERGY COMMISSION, <http://www.aec.gov.in/> (last visited Apr. 23, 2011); GOV'T OF INDIA, MINISTRY OF ENV'T & FORESTS, ENVIRONMENTAL IMPACT ASSESSMENT GUIDANCE MANUAL FOR NUCLEAR POWER PLANTS, NUCLEAR FUEL REPROCESSING PLANTS AND NUCLEAR WASTE MANAGEMENT PLANS 6 (2010), available at http://moef.nic.in/Manuals/Nuclear%20Power%20Plants_may-10.pdf.

160. Ajoy Ashirwad Mahaprahasta, *Lack of Mechanisms to Monitor the Import of Hazardous Waste and the Unchecked Waste Industry Are Making India a Dump Yard*, TOXIC TRADE NEWS, May 22-June 4, 2010, http://www.ban.org/ban_news/2010/100522_importing_trouble.html.

early on in the U.S.-India Civilian Nuclear deal, Prime Minister Singh noted, without mentioning issues of waste management, that India had a “comprehensive nuclear infrastructure.”¹⁶¹ Had the government compared its waste management plan with that of the United States, as it did the amount of electricity generated in the two countries, public data about the problem of waste management would be available to show what the United States—a country larger and less densely populated than India—faces in disposing its waste.¹⁶² The Indian government appears to have produced no such public data.

Flaws in national nuclear waste management regulation are compounded by ineffective international controls. While the International Atomic Energy Agency (IAEA) is aware of the legal shortcomings in managing waste management issues associated with the resumption of civilian nuclear energy activities, it is relatively powerless to redress the problem.¹⁶³ The IAEA’s authority to examine nuclear facilities is governed by the Safeguards Agreement, which emphasizes securing facilities against diversion of technology for weapons development and not environmental safety.¹⁶⁴ Even the underlying Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (Joint Convention),¹⁶⁵ which India has not

161. Prime Minister Manmohan Singh, Statement in the Lok Sabha on Civil Nuclear Energy Cooperation with United States (Aug. 13, 2007), <http://pmindia.nic.in/speech/content4print.asp?id=569>.

162. See ENVTL. PROT. AGENCY, MUNICIPAL SOLID WASTE IN THE UNITED STATES 1 (2007), available at <http://www.epa.gov/waste/nonhaz/municipal/pubs/msw07-rpt.pdf>. See also PEOPLE: HOBART AND WILLIAM SMITH COLLEGES, LANDFILLS: WHERE DOES OUR TRASH GO? 1-12 (n.d.), available at <http://people.hws.edu/halfman/Data/PublicInterestArticles/Landfills.pdf>.

163. Yury Sokolov, Statement at International Conference on Management of Spent Fuel from Nuclear Power Reactors (May 31, 2010), <http://www.iaea.org/NewsCenter/Statements/DDGs/2010/sokolov310510.html> (noting the importance of dealing with spent fuel and the issue of plutonium management that will be generated if spent fuel is reprocessed).

164. “The purpose of safeguards under this Agreement is to guard against withdrawal of safeguarded nuclear material from civilian use at any time.” Safeguards Agreement, *supra* note 89, at art. 1(B)(3). “[T]he Agency shall implement safeguards in a manner designed to avoid hampering India’s . . . development, and not to hinder or otherwise interfere with any activities involving the use by India of nuclear material. . . or technology. . .” *Id.* at art.1(B)(5).

165. IAEA JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT 1 (1997), available at <http://www.iaea.org/Publications/Documents/Infcircs/1997/infcirc546.pdf>.

yet signed, only creates broad obligations with no sanction for violations.¹⁶⁶

Nuclear safety is also compromised by India's civilian liability legislation. The initially proposed bill limited liability to operators but not to equipment suppliers and caps operator liability at 500 crores, which roughly translates to U.S. \$200 million under current exchange rates.¹⁶⁷ The government or taxpayers would also bear any liability that exceeded the capped amount, but such liability was also capped at 300 million Special Drawing Rights (SDR), which is tied to the International Monetary Fund (IMF).¹⁶⁸

Not only was the capped amount extremely low in comparison with United States legislation,¹⁶⁹ but it also demonstrated insufficient government attention to the potential severity of a nuclear accident, which according to some estimates could cost millions of dollars.¹⁷⁰ Further, since all nuclear energy power is owned by the government per the Atomic Energy Act of 1962,¹⁷¹ it ap-

166. *Id.*

167. India Civil Nuclear Liability Bill, *supra* note 126, § 6(2). See Anirudh Burman, *Bill Summary, The Civil Liability for Nuclear Damage Bill*, PRS LEGISLATIVE RESEARCH (May 7, 2010), available at <http://www.prsindia.org/uploads/media/Nuclear/Summary%20Civil%20Liability%20for%20Nuclear%20Damage%20Bill%20202010.pdf> for a brief overview of the bill.

168. India Civil Nuclear Liability Bill, *supra* note 126, § 6(1). See *Factsheet: Special Drawing Rights*, INT'L MONETARY FUND (Sept. 29, 2010), <http://www.imf.org/external/np/exr/facts/pdf/sdr.pdf> for an overview of SDRs. The amended Bill passed by the Lok Sabha applies this cap only to each nuclear incident. The liability of the operator, however, has been increased on a graded scale depending on the size of the nuclear facility in terms of the energy produced. Such liability is not tied to SDR. See Michel-Kerjan & Decker, *supra* note 124, at 126.

169. In the United States, the total liability amounts to \$10 billion; operators are individually liable up to for \$300 million; and operators are collectively, through an insurance that they annually pay to a fund, liable for \$15 million.

170. See U.S. GENERAL ACCOUNTING OFFICE, GAO/RCED-87-214, NUCLEAR REGULATION: A PERSPECTIVE ON LIABILITY PROTECTION FOR NUCLEAR ACCIDENT 18 (1987), available at <http://archive.gao.gov/d28t5/133093.pdf> (noting in Chapter 2 that the cost of severe and catastrophic nuclear accidents could exceed the liability amount).

171. See The Atomic Energy Act, No. 33 of 1962, INDIA CODE, Art. 3(a), available at <http://www.dae.gov.in/rules/aeact.pdf> (noting that the Central government has the power to "produce, develop, use and dispose of atomic energy either by itself or through any authority or Corporation established by it or a Government company and carry out research into any matters connected therewith"); see also GOV'T OF INDIA, NATIONAL REPORT TO THE FOURTH CONVENTION ON NUCLEAR SAFETY: FOURTH REVIEW MEETING OF CONTRACTING PARTIES 3 (2007), available at <http://www.dae.gov.in/press/cnsrpt.pdf> (noting that under the Atomic Energy Act only companies owned by the Central government "are permitted in the field of nuclear power generation.").

peared that most nuclear facilities would be excluded from this Bill.¹⁷²

While the amended Bill has addressed several of these problems, it does not in substance address the shortcomings of the previous Bill for several reasons. First, even though the new version incorporates suppliers' liability, only an operator who has paid compensation can pursue action, and only willful or grossly negligent intentional acts are actionable.¹⁷³

The amended Bill also increased the cap limits on liability to Rs. 1,500 crores depending on the capacity and primary function of a plant, and the government retains discretion to impose liability for a nuclear incident above the capped amount of 300 million SDR and to reduce liability for smaller operators.¹⁷⁴ However, because the Bill specifically allows only operators who are owned or controlled by the government directly or indirectly to operate nuclear power plants,¹⁷⁵ any change in liability caps affect taxpayers. It may be worth noting that the recent BP oil spill demonstrates that safety cannot be assumed away, and this incident has led to calls for removing caps on liability, including rethinking caps for nuclear accidents under the Price Anderson Act.¹⁷⁶

Cracks in the government's preparedness to fully anticipate the challenges of establishing nuclear facilities have already appeared in the early stages of four siting applications; the Ministry of Environment and Forests has rejected four applications submitted by the Nuclear Power Corporation Limited for incomplete documentation of required information.¹⁷⁷ Arguably, the apparent vigilance of the environmental ministry may be a positive sign that somewhat mitigates the concerns. However, public resistance from farmers who are concerned about the siting of

172. See *The Civil Liability for Nuclear Damage Bill, 2010*, PRS LEGISLATIVE RESEARCH, http://www.prsindia.org/index.php?name=Sections&action=bill_details&id=6&bill_id=1042&category=42&parent_category=1 (last visited Mar. 10, 2011).

173. *Id.*

174. *Id.*

175. *Id.*

176. For an overview of events leading to the spill and subsequent responses, see *Timeline-Gulf of Mexico Oil Spill*, REUTERS (Africa), July 27, 2010, <http://af.reuters.com/article/energyOilNews/idAFN2724557220100727?sp=true>; see also Richard A. Epstein, *BP Does Not Deserve a Liability Cap*, WALL ST. J., June 16, 2010, <http://online.wsj.com/article/SB10001424052748704312104575298902528808996.html?KEYWORDS=Richard+Epstein> (arguing that caps on nuclear accident liability must also be rethought in light of the BP oil spill).

177. Nitin Sethi, *Four New Proposed Nuke Plants Hit Green Hurdle*, ECON. TIMES, July 20, 2010, <http://economictimes.indiatimes.com/news/news-by-industry/et-cetera/Four-new-proposed-nuke-plants-hit-green-hurdle/articleshow/6189664.cms>.

nuclear facilities in their neighborhoods also demonstrates that the government has not adequately considered public opinion regarding nuclear energy.¹⁷⁸

It is also unclear how India will provide cooling water for new reactors without affecting the ecology or ensure safety in all facilities.¹⁷⁹ There is clearly room for worry when the former chairperson of the Atomic Energy Research Board opines that, despite being a Party to the Convention on Nuclear Safety,¹⁸⁰ India has a poor record of safety and has even violated its own legislation.¹⁸¹ All these problems could have international repercussions as India implements all of its bilateral arrangements.

India's case study demonstrates that India and other nations' expansion of nuclear energy programs will neither produce the positive result of reducing greenhouse gas emissions nor mitigate potential related environmental problems. Nuclear energy within the current legal structure is a lose-lose proposition that deserves much more legal scrutiny than it has received. To be sure, the consequences of climate change unraveling amidst several nuclear facilities governed by ill thought-out environmental and safety rules are unthinkable. There is an urgent need to design international and domestic rules on nuclear energy and also to reconsider current approaches to emissions reduction that may lead nations to pursue environmentally catastrophic alternatives without much forethought.

178. *Id.* See also Vinaya Deshpande, *Protest against Jaitapur Nuclear Plant*, THE HINDU, Dec. 5, 2010, <http://www.hindu.com/2010/12/05/stories/2010120562481000.htm>.

179. According to a brief prepared by the Union for Concerned Scientists, providing cooling water presents several challenges, including providing uninterrupted supply and preventing ecological damages such as radioactive pollution of the water. GOT WATER?, UNION FOR CONCERNED SCIENTISTS 5 (2007), available at http://www.ucsusa.org/assets/documents/nuclear_power/20071204-ucs-brief-gotwater.pdf. See also Radha Neelkantan, *Facing Water Crisis, India Should Look Beyond Nuclear Energy*, REVOLT: WORLDWATCH INST. CLIMATE & ENERGY BLOG (Mar. 19, 2010), <http://blogs.worldwatch.org/revolt/facing-a-water-crisis-india-should-look-beyond-nuclear-energy/> (arguing that given India's water shortage problems and the type of technology being deployed, India should rethink its nuclear energy policy).

180. IAEA, CONVENTION ON NUCLEAR SAFETY 1-14 (1994), available at <http://www.iaea.org/Publications/Documents/Infcircs/Others/inf449.pdf>.

181. A. Gopalakrishnan, *Issues of Nuclear Safety*, FRONTLINE, Mar. 13-26, 1999, <http://www.hinduonnet.com/fline/fl1606/16060820.htm>.

VII.

CONCLUSION: ACKNOWLEDGING AND ADDRESSING
THE CLIMATE-NUCLEAR LINK

Excluding nuclear energy from the international climate change regime for environmental reasons has not slowed the expansion of nuclear power. On the contrary, India and other nations are piggybacking on climate change to achieve their long-term energy security goals. This is a troubling development, because the absence of proper international and domestic legal infrastructure and strategies for reducing emissions and managing environmental and safety impacts of nuclear energy demonstrates the inadequacies of both global climate and environmental governance.

A better approach is necessary to address the issue of nuclear energy in a more meaningful manner, including establishing a coherent environmental governance mechanism, proper assessment of the risks involved, and prioritization of environmental protection goals. To the extent that nations continue to expand their nuclear energy, nuclear energy should be included within an international climate regime; indeed, current approaches to climate change under the Kyoto Protocol may require reconsideration.

Reducing greenhouse gas emissions has not only become an important environmental issue, it has become *the* environmental issue. The problem with this situation is that nations have not figured out a way to effectively reduce emissions, primarily because climate change is also an economic issue and reductions would call for either new sources of energy in our current growth model or an entirely new economic growth model. Absent any new ideas regarding the latter, nations are focusing on maintaining the current model of economic growth, while at the same time promoting new sources of energy and seeking emissions reduction. However, balancing all three concerns—emissions, economics, and energy—is difficult, if not downright improbable when national objectives on all three issues are not aligned.

India's case shows that its energy, security, and economic growth law and policy do not correspond to its position on emissions reduction. The fairness of such policy is beside the point; what matters is dealing with the realities of the emission-energy-economics dilemma by taking new approaches to climate change mitigation. The current approach is fixated on reducing emissions within a targeted time period. Instead, nations should establish a climate assessment system, under which nations make

efforts to phase out sources of energy that are found to contribute to climate change, while at the same time establishing transparent mechanisms to assess the efficacy of alternative energy sources. Under such an approach, nations will have to demonstrate with reasonable certainty that the proposed technology will mitigate climate change within a particular time. Nations should also grant international incentives such as tariff exemptions under the General Agreement on Tariffs and Trade (GATT) to such technologies or establish special investment regimes to promote their development.¹⁸² At the same time, technologies such as nuclear energy that do not timely contribute to climate mitigation and that may present environmental problems must be discouraged through a system of disincentives, or their use must be promoted under a legal framework that maximizes their contribution to emissions reduction and minimizes their environmental impact. Without a fresh approach, the continuing stalemate on climate change presents a bleak picture. Even worse, it may cause nations to adopt alternatives that will lead to further environmental deterioration.

182. See, e.g., K. RAVI SRINIVAS, CLIMATE CHANGE, TECHNOLOGY TRANSFER AND INTELLECTUAL PROPERTY RIGHTS 1-26 (2009), available at <http://econpapers.repec.org/paper/eabgovern/2213.htm> (arguing for a relaxed Trade-Related Aspects of Intellectual Property Rights (TRIPS) regime in transferring climate friendly technology); see also Jonathan Zasloff, *Choose the Best Answer: Organizing Climate Change Negotiation in the Obama Administration*, 103 Nw. U. L. REV. 330, 340-41 (2009) (arguing that the Office of the United States Trade Representative may be a better climate negotiator for the United States because of its influence and the fact that the World Trade Organization is one of the most effective international organizations).

